

mHealth Field Guide for Newborn Health

January 2014



USAID
FROM THE AMERICAN PEOPLE



Advancing community health worldwide.

Abstract

The early concentration of risk in a child's life calls for dedicating resources around delivering quality care at the time of birth and weeks after birth. Mobile health, or "mHealth", addresses the use of mobile and wireless technologies for providing health services and information. Newborn health can be supported by mHealth through referral and tracking of mothers and infants, decision support for CHW, CHW supervision, scheduling and tracking postpartum and postnatal visits, and teaching and counseling for mothers and families, among other uses. These are reviewed in case studies from Afghanistan, India, Malawi and Indonesia. These case studies are framed by a review of implementation issues and external resources for guidance.

Recommended citation:

Keisling, K. mHealth Field Guide for Newborn Health. January 2014. Washington, DC: CORE Group

CORE Group improves and expands community health practices for underserved populations, especially women and children, through collaborative action and learning. Through its Community Health Network, CORE Group brings together its 70+ Member and Associate Organizations along with the extended global health community to network, share knowledge, identify gaps, and create and promote evidence-based tools that increase the impact and sustainability of maternal and child health programming around the world. To learn more, visit www.coregroup.org. To sign up for the mHealth listserv, please visit <http://www.coregroup.org/get-involved/listserv-sign-up>.

CORE Inc. (CORE Group)

Phone: (202) 380-3400 | email: contact@coregroupdc.org

www.coregroup.org

Acknowledgements

CORE Group would like to thank the steering committee members for their guidance in designing this report. Guidance was provided by Alfonso Rosales (World Vision), Carolyn Kruger (PCI Global), Dennis Cherian (World Vision), GERALYN Sue Prullage (neonatal/pediatric nurse practitioner), Jeanne Koepsell (Save the Children), Joan Haffey (CORE Group), Karen LeBan (CORE Group), Marianna Hensley (Catholic Relief Services) and Shannon Downey (CORE Group).

CORE Group would also like to thank staff of organizations that provided interviews and material for case studies, specifically World Vision, Dimagi, Catholic Relief Services, Village Reach, Concern Worldwide, Jhpiego and RTI.

Support for the report was provided by Dimagi through a USAID Development Innovation Ventures Grant No. AID-OAA-F-12-00018. This publication does not necessarily reflect the views of USAID or the United States Government. It may be reproduced if credit is properly given.

The report was authored by Kelly Keisling, chair of the mHealth Interest Group at CORE Group. For more information, please contact contact@coregroupdc.org

Graphic Design:

Pinky Patel, CORE Group

Photo Credits:

Cover: © 2011 Cameron Taylor, Courtesy of Photoshare

Page 2: © 2004 Philippe Blanc, Courtesy of Photoshare

Table of Contents

Executive Summary 1

Overview of Newborn Health 2

Overview of mHealth 2

How mHealth Can Support Key Practices for Newborn Health 3

Case Studies:

Better Health for Afghan Mothers and Children (BHAMC) 6

Reducing Maternal and Newborn Deaths (ReMiND) 9

Chipatala cha pa Foni (CCPF) 13

Sistem Informasi Jejaring Rujukan Maternal & Neonatal
(SIJARIEMAS) Referral Exchange System 18

Implementation Issues and Planning Resources 22

Conclusion 25

References 26

External Resources 27

Executive Summary

The day a baby is born is the most dangerous day of its life. The early concentration of risk in a child's life calls for dedicating resources around delivering quality care at the time of birth and weeks after birth. Mobile health, or "mHealth," addresses the use of mobile and wireless technologies for providing health services and information. Newborn health can be supported by mHealth in many key ways, including:

- Referral and tracking of mothers and infants
- Decision support for CHW
- CHW supervision
- Scheduling and tracking postpartum and postnatal visits
- Teaching and counsel for mothers and families

These uses of mHealth are reviewed in the following case studies:

- Better Health for Afghan Mothers and Children (Afghanistan) by World Vision and Dimagi
- Reducing Maternal and Newborn Deaths (India) by Catholic Relief Service, Dimagi and Vatsalya
- Chipatala cha pa Foni (Malawi) by VillageReach, Concern Worldwide and partners
- SIJARIEMAS Referral Exchange System (Indonesia) by RTI with EMAS partners

These case studies provide lessons learned on implementation issues, including:

- **Quality of design:** sufficient time, budgeting and design methods are required
- **Narrow technological approach to ICT:** understand the needs of users and beneficiaries
- **Changes in communication patterns:** fit users' communication patterns and preferences
- **Changes in the power structure:** gender can influence project design
- **Demand:** demand generation can support adoption by users and gatekeepers
- **Modifications to planned implementation:** reduce modifications with simple features
- **Project planning and management:** sufficient time, staffing and supervision are required
- **Costs:** costs vary but various strategies are available for reducing or sharing costs
- **Organizational capacity:** trainings, guides and technical assistance can address challenges
- **Government commitment and capacity:** align with government goals and expectations
- **Partnerships:** development and scale up can shift responsibilities to new partners

Collaboration and capacity building can address the opportunities and challenges in mHealth for newborn health. This Guide supports consideration of mHealth options by field staff in newborn health projects. It references other sources for more comprehensive information on mHealth or newborn health. The Guide instead focuses on practical examples and lessons from the intersection of mHealth innovation and newborn health needs.

Overview of Newborn Health

Almost 3 million babies die worldwide during their first month of life. As progress is made toward Millennium Development Goal (MDG) 4 to reduce child mortality, newborn mortality has declined globally from 4.4 million in 1990 to 2.9 million in 2012. But the decline in newborn mortality is slower than the decline for under-five deaths. This means that the proportion of under-five deaths that occur during the first four weeks of life has increased.¹

The day a baby is born is the most dangerous day of its life, as over 1 million children die each year on the day they are born.² Up to one half of all newborn deaths occur within the first 24 hours of life and 75% occur in the first week.³ The early | concentration of risk in a child's life calls for dedicating resources around delivering quality care at the time of birth and weeks after birth.⁴

The three main causes of newborn death are prematurity, complications during childbirth, and neonatal infections.⁵ About 40% of women in developing countries do not have a skilled birth attendant during childbirth, and less than 40% of women and infants receive a postnatal visit.⁶

Preparation for and care provided at birth supports multiple goals related to the health of mothers and newborns.⁷ The Continuum of Care for reproductive, maternal, newborn and child health includes integrated service delivery for women and children from pre-pregnancy to delivery, the immediate postnatal period, and childhood. Care is provided at multiple levels by families and communities, and through outpatient services, clinics and other health facilities.⁸

→ See the [Healthy Newborn Network](#)



Overview of mHealth

Mobile health, or “mHealth,” addresses the use of mobile and wireless technologies for providing health services and information. This can include use of mobile phones, personal digital assistants (PDAs), tablets, mobile applications and wireless medical devices. It is part of the larger field of eHealth, which covers broader information and communications technologies (ICT) for health, such as computers and the internet. It is also part of the cross-sector use of ICT for development (ICT4D).

Mobile technology can be used for a wide range of purposes, including service delivery, social and behavior change communication, data collection and information systems, supply management, health worker supervision and performance support, and financial transactions and incentives.⁹ Mobile technologies cannot physically deliver commodities, personnel and equipment, but they can deliver related information for health projects.¹⁰

→ See [mHealth Basics: Introduction to Mobile Technology for Health](#)

The evidence base for mHealth is limited but growing. There have been critiques of insufficiently rigorous evaluation in hundreds of pilot studies of mHealth.¹¹ But rigorous evaluation is accumulating rapidly with 40 new studies added to the [clinicaltrials.gov](#) database between May and November 2012 alone.¹²

→ See [mHealth and MNCH: State of the Evidence](#)

→ See broader literature on [mHealth evidence](#)

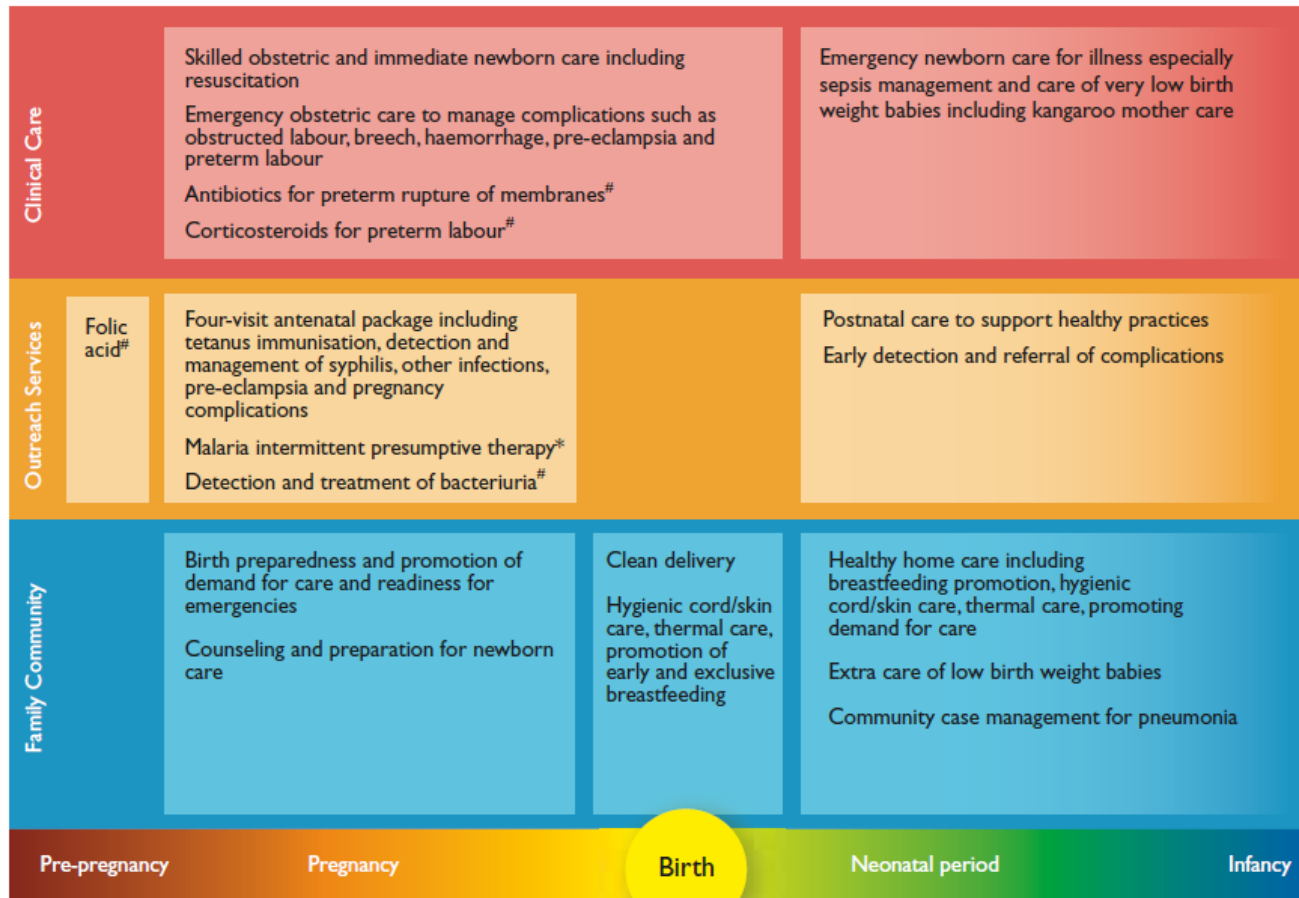
How mHealth Can Support Key Practices for Newborn Health

There are a range of interventions with proven efficacy in reducing neonatal mortality that cross levels of care and the continuum of care. Among the many important interventions, below are key interventions with primary effect on neonatal deaths.

High-impact, simple intervention to save newborn lives within the continuum of maternal and child health care

The Lancet. The Executive Summary of the Lancet Neonatal Survival Series.

http://www.who.int/maternal_child_adolescent/documents/pdfs/lancet_neonatal_survival_exec_sum.pdf. Accessed Nov. 18, 2013. Nov. 2013.



Immediate focus on newborn health

Integration of care is emphasized within the broader continuum of reproductive, maternal, newborn and child health (RMNCH). Mobile technologies can support care across the entire continuum.

- See [Leveraging Mobile Technologies for Maternal, Newborn & Child Health](#)
- See the [mHealth and ICT Framework for RMNCH](#)
- See [mHealth, eHealth, Reproductive Health](#)

Given the concentration of risk in the first day and month of a child’s life, this Guide will focus on examining mHealth for newborn health.

Illustrative Ways that mHealth Can Support Newborn Health

Level of Care	Ways to Strengthen Care
Clinical Care	Referral and Tracking
Outreach Services	Decision Support for CHW CHW Supervision Scheduling and Tracking Follow Up Visits
Family/Community	Teach and Counsel

mHealth can support newborn health in each of these ways:

- **Referral and Tracking:** Facility-based birth can provide access to a skilled birth attendant. CHWs can use a mobile phone to refer mothers showing danger signs to a facility, alert the facility, and track the mother’s arrival.
- **Decision Support for CHW:** Mobile phones can provide step-by-step guidance to CHWs for assessment, treatment and/or referral based on community case management or IMNCI protocols. CHWs can contact mentors via phone when they need guidance to stabilize mothers.
- **CHW Supervision:** CHWs may lack sufficient face-to-face supervision at the community level. Supervisors can use mobile phones to monitor CHW data entry and activities, or to send alerts to CHWs when postpartum visits are not reported.
- **Scheduling and Tracking Follow Up Visits:** Postpartum and postnatal visits should be conducted within 3 days of birth to mothers who delivered in facilities or at home.¹³ Follow up visits can be scheduled, reminded, and tracked by mobile phone. Mobile phones can support this with birth registrations.

- **Teach and Counsel Mother and Family:** Teaching and counseling on newborn health is often required for the mother and family.¹⁴ Mobile phones can be used by CHWs and by mothers or families to receive information on how to care for the newborn and how to recognize danger signs.

The ways that mHealth serves newborn health are demonstrated in the case studies listed below.

Type of mHealth	Case Study
Referral and Tracking	<ul style="list-style-type: none"> • Better Health for Afghan Mothers and Children • Reducing Maternal and Newborn Deaths • SIJARIEMAS Referral Exchange System • Chipatala cha pa Foni
Decision Support	<ul style="list-style-type: none"> • Better Health for Afghan Mothers and Children • Reducing Maternal and Newborn Deaths
CHW Supervision	<ul style="list-style-type: none"> • Better Health for Afghan Mothers and Children • Reducing Maternal and Newborn Deaths
Scheduling and Tracking Follow Up Visits	<ul style="list-style-type: none"> • SIJARIEMAS Referral Exchange System • Reducing Maternal and Newborn Deaths
Teach and Counsel Mother and Family	<ul style="list-style-type: none"> • Reducing Maternal and Newborn Deaths • Chipatala cha pa Foni • SIJARIEMAS Referral Exchange System

The reviewed projects can each use multiple types of mHealth. However, mHealth is uniquely designed to serve each project’s needs in newborn health and broader MNCH. These projects are reviewed in the following case studies.

Better Health for Afghan Mothers and Children

Afghanistan: World Vision and Dimagi

Referral and Tracking

Decision Support & CHW Supervision

Better Health for Afghan Mothers and Children (BHAMC)¹ project uses mHealth for community health workers in the Herat Province of Afghanistan.

PROBLEM STATEMENT

Women in Afghanistan have low access to maternal care services. Access is limited by geographical barriers in a country where 80% of the population lives in rural areas. Culturally-determined care seeking behavior is also a barrier to maternal and newborn health. Health facilities are badly understaffed. Due to an insecure environment, staff members could not visit the communities to train the volunteers and oversee implementation.

PROJECT OVERVIEW

BHAMC used a community-based maternal care strategy (Home-Based Life Saving Skills - HBLSS) to improve preventive, homecare, and care seeking practices among pregnant women. Working with Dimagi's CommCare application, the project designed a mobile phone maternal and newborn healthcare application to be used by community health workers as they advise community members. During May 2011 to December 2012, five CHW couples visited pregnant women at key times during pregnancy and postnatal and for making referral calls. The phone application served as 1) a job aid for CHWs and informing mothers, 2) emergency call and referral and 3) reporting home visits. As a job aid, the application reminded CHWs of key messages. It was a resource for CHWs to share information with mothers. CHWs talked with pregnant women regarding the need for antenatal care visits and delivering in a facility, planning and preparing for birth, danger signs during pregnancy, labor, delivery, caring for a newborn, and the need for facility birth with the family and facilitated related decisions. When a woman went into labor, the CHWs made a referral call and linked the woman's family with a skilled provider at the nearest facility. CHWs were able to advise families on available transportation, including ambulances if available. It also helped communication with facility staff. The project manager was able to provide timely feedback to CHWs in the intervention area as the data was received in real time.

¹ BHAMC is funded by a USAID Child Survival and Health Grants Program award to World Vision

PROJECT MANAGEMENT, STAFFING AND PARTNERSHIP

- *World Vision* was responsible for developing and translating newborn health content for modules. World Vision also supervised CHWs and their reporting. World Vision had to recruit a full-time staff to manage the mHealth project. World Vision offices in Afghanistan and Washington DC both had access to system data, enabling feedback and troubleshooting.
- *Dimagi*, an open-source developer for mobile technology, led application development and provided landscape analysis and technical support. Dimagi also led the training workshop for CHWs.

DEVELOPMENT PROCESS

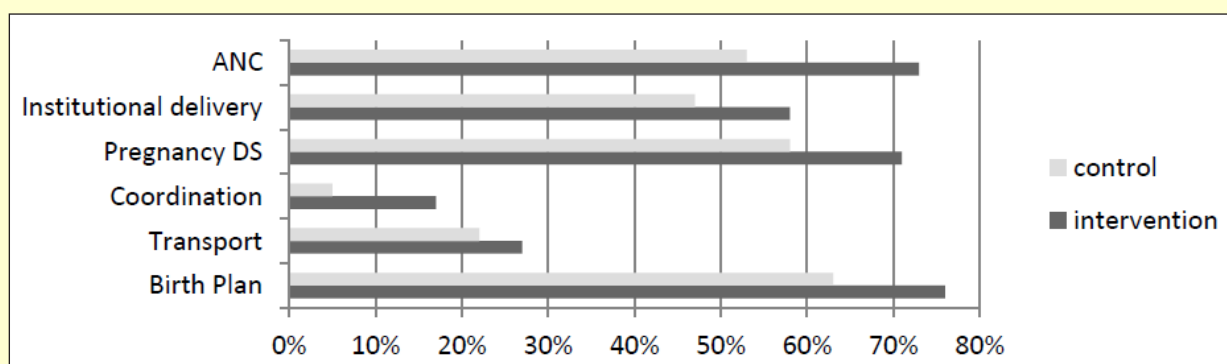
Content was provided by World Vision and became CommCare content. Two modules were developed for antenatal care and another for postnatal care, based on nine modules of the Home Based Life Saving Skills (HBLSS)¹¹, a family-focused, community-based program to reduce maternal and neonatal mortality. A checklist and logic model was created for every module. The modules were developed in the local language and in visual and audio formats. Training lasted several weeks, with follow up over months. A database was also set up at the project office and at World Vision headquarters to access data in real time.

RESULTS

The operations research study used a pretest-posttest design with baseline (2010) and end line (2012) household surveys carried out in five intervention and five comparison sites. The total sample size was 206 mothers with children less than 24 months of age, 103 located at the intervention site and 103 at comparison sites. The study included a small sample size of five couples of male and female CHWs for each the intervention and control. Data on 15 indicators was collected, after 20 months of program intervention, finding changes in 7 (47%) health related behaviors. The use of the mobile application produced changes on the development of birth plans (+12.6%), antenatal care visit (+20%), planning for transportation (+4.8%), coordination with health facilities (+12.6%), knowledge of danger signs during pregnancy (+12.9%), institutional deliveries amongst women (+11.6%), and early initiation of breastfeeding (8.7%).

¹¹ <http://www.midwife.org/Home-Based-Life-Saving-Skills-HBLSS>

Changes in health related behaviors with use of mobile application



The intervention did not have any impact on behaviors related to knowledge of newborn danger signs, iron supplementation, postnatal visits, and early initiation of breastfeeding. Substantial increases, both at intervention and comparison sites, were found on the prevalence of money saved for delivery, community health worker home visits, and the number of these visits.

Focus group discussions were conducted with seven mHealth CHWs and eight shura (village health committee) members. Discussions indicated:

- Using mHealth can improve knowledge of mothers on health issues—they became more enthusiastic to listen and learn properly.
- Mothers look to the mobile phones for new information, indicating their confidence or belief in the quality of information regarding health issues that comes from the phones.
- CHWs are better able to access and deliver medical supplies as needed during winter months when supplies are scarce, which reinforces mothers' trust and confidence in CHWs with mobile phones.

NEXT STEPS

Implications for scale up include costs, training of CHWs, and harmonizing the mobile phone data with that in the district-level health information system. Areas that are more remote than the study sites tend to have limited transmission coverage, which could limit scale up. Designing mHealth projects is difficult due to limited capacity with innovative technology. Capacity building in mHealth is needed at the country level. This can include comprehensive training packages, technical support and guidelines.

Reducing Maternal and Newborn Deaths (ReMiND)

India: Catholic Relief Service, Dimagi and Vatsalya

Referral and Tracking Decision Support, CHW Supervision, Scheduling and Tracking Follow Up Visits

Teach and Counsel Mother and Family

The Reducing Maternal and Newborn Deaths (ReMiND)ⁱⁱⁱ Project supports maternal, newborn and infant survival in Kaushambi District of Uttar Pradesh through mHealth for community health workers.

PROBLEM STATEMENT

Newborn health issues in central India include preterm birth/low birth weight, infection, birth asphyxia/trauma, delayed initiation of breastfeeding, non-exclusive breastfeeding, early newborn bathing, application of mustard oil to the umbilical cord stump, incomplete immunizations, poor complementary feeding, and delayed care seeking for illness. Postpartum care is low, including lack of identification and treatment or referral of danger signs. There is understaffing of health staff at facilities. Government community health workers (called ASHAs—Accredited Social Health Activists) are used and incentivized, but have minimal training, supervision and job aids.

PROJECT OVERVIEW

The ReMiND Project contributes to improvements in maternal, newborn and infant health outcomes in target counties of Kaushambi District during 2012-2015. It specifically supports 1) strengthened support structures and supervision mechanisms for the ASHA; 2) improved maternal and newborn referrals by an ASHA; and 3) improved ASHA skills in identifying and referring based on maternal and newborn danger signs. ReMiND is designed to improve interpersonal communication and counseling by an ASHA during pregnancy and postpartum home visits, and to increase MNCH knowledge among pregnant women, mothers and their families. The project targets 259 ASHAs, 56 auxiliary nurse midwives, 84 ASHA supervisors and 24 block, district, and state health authorities. Through the ReMiND Project, ASHAs use basic cell phones running Dimagi's open source CommCare software. The software includes pregnancy, postpartum, infant and referral modules. Since many ASHAs are illiterate, these modules use audio and visual prompts to help ASHAs systematically counsel and assess women and babies for any danger signs during home visits before and after birth. Each module also contains in-depth counseling forms that systematically guide ASHA as they counsel pregnant and postpartum women and their families about key MNCH practices. Using CommCare,

ⁱⁱⁱ ReMiND is funded by a USAID Development Innovation Fund Program award to Dimagi, Inc. plus private fund of Catholic Relief Services

every supported pregnant woman is registered and tracked through pregnancy, delivery and the postpartum period with continued tracking of infants through their first year of life. Once a birth is reported, interactive voice response (IVR) reminders repeatedly prompt the ASHA to conduct a postpartum visit until that visit is recorded in CommCare.

A related application was later added for ASHA supervisors to strengthen support structures and supervision mechanisms for ASHAs. CommCare also alerts ASHA supervisors via SMS if ASHAs miss postpartum home visits. At the request of health authorities in Uttar Pradesh, the project's original supervisory component is being aligned to government guidance for broader rollout to a new cadre of ASHA supervisors being introduced by the state.

PROJECT MANAGEMENT, STAFFING AND PARTNERSHIP

- ReMiND has a decentralized management and staffing plan. The project team of Catholic Relief Services (CRS) includes a full-time Program Coordinator with overall responsibility for project management, and a Program Officer who is responsible for day-to-day support to the local implementing partner for project execution. Three members of CRS' IT team in India also provide periodic support for building CommCare applications and technology troubleshooting. The local implementing partner is Vatsalya, a nationally recognized leader in maternal and newborn health that executes project activities at the district level. The IT partner is Dimagi, which has worked to develop and deploy electronic medical records, mobile data collection and decision support, SMS-based outreach and other electronic systems in over 25 countries with numerous partners.
- CRS leads ReMiND application design and development of training modules. It also supports and/or leads the build-out of ReMiND CommCare applications and provides ICT technical support. CRS provides training support for rollout. CRS also provides management quality support and ensures active engagement of district and state-level health officials. CRS oversees project monitoring, evaluation and documentation.
- *Dimagi* leads field iterations of CommCare applications. It leads identification of the appropriate technical support plans, data plan and phone model. Dimagi leads or provides technical backstopping to CRS for application building and backstops for technical support. It supports development of ICT training content and provides training support for rollout. Dimagi engages primarily at the headquarters level for strategy, application design and capacity building of CRS IT

staff. Dimagi works at the field level for initial training support, field testing, and iteration of the application.

DEVELOPMENT PROCESS

CRS and Dimagi cooperated to identify the work flow of ASHAs and supervisors. CRS then led development and adaption of content in consultation with district and state health authorities and project partners. Dimagi adapted and reused a file for pregnancy checklists, while CRS defined the skip logic for forms. Mobile content for ASHAs was designed to reinforce MNCH content on which they were trained by the government and to serve as a “conversation starter” to strengthen the quality of the ASHAs interaction with women and family members. Mobile experience surveys were used to test the phone literacy of users. Given that some ASHAs are illiterate, multimedia still images and audio were added. A separate application was later developed for supervisors that includes checklists for supervisors to observe the quality of ASHAs’ counseling, and to assess ASHAs’ mobile experience and skills. It also reports and tracks technology issues that ASHAs encounter with the application or mobile phone.

RESULTS

The ReMiND project will reach almost 33,000 pregnant women and more than 20,000 young children by 2015. To date, more than 9,000 pregnant women and 5,000 children have been registered and tracked through ReMiND’s mobile application. CRS also conducted a knowledge, practice and coverage survey of more than 1,100 households to form a baseline against which project-related changes in health outcomes will be measured. Initial results show that the mobile pregnancy application facilitated a 24% increase in ASHAs’ knowledge of high-impact maternal and newborn care interventions. Through ReMiND’s supervision application, the project has recorded a 136% increase in clients who ask ASHAs questions during home visits. There has also been a 68% increase in ASHAs who encourage clients to use the next recommended health service since they started using the ReMiND application. Among pregnant women supported by ASHAs using the app, 78% give birth in health facilities compared to only 60% of women in the general population. In addition, qualitative information shared by ASHAs indicates that the mobile phone-based tool helps them better manage their workloads and improves the quality of their counseling.

ASHAs also say that audio on the mobile application is often perceived by families as an authoritative outside voice that increases the families' receptiveness to key maternal and newborn health messages. Pregnant women report that the application's interactive multi-media format is more engaging than traditional flip charts.

NEXT STEPS

ReMiND is scaling its ASHA supervision application to all eight counties in the Kaushambi District and has been requested by the government to introduce the supervision application in one county of the state capital so that state health authorities can engage directly in implementation.

If successful, the government could scale the supervision application across Uttar Pradesh.

Outstanding considerations for scale-up include how the state would provide IT maintenance and policies for phone loss/damage. Dashboards are being made available for government officials with built-in analytics, which is faster and easier than training government counterparts in data analysis.

Chipatala cha pa Foni (CCPF)

Malawi: VillageReach, Concern Worldwide and partners

Teach and Counsel Mother and Family

Chipatala cha pa Foni (CCPF)^{iv} is a hotline and voice/text based tips and reminders service providing women and guardians of young children in rural and underserved areas with access to information, medical advice and referrals on reproductive, maternal, newborn, and child health (RMNCH) issues. Chipatala cha pa Foni means Health Center by Phone. It aims to increase knowledge and improve health seeking behavior among pregnant women, guardians of young children and women of child-bearing age. VillageReach developed and implemented the service for Concern Worldwide's Innovations for Maternal, Newborn, and Child Health (Innovations) initiative in Balaka District in Malawi. Innovations is a global initiative led by Concern Worldwide US to support inventive ways to overcome barriers to delivering proven maternal, newborn, and child health solutions.

PROBLEM STATEMENT

Maternal, newborn, and child mortality rates in Malawi are among the highest in the world. The maternal mortality ratio is 675 maternal deaths per 100,000 live births and the under-five mortality rate is 112 deaths per 1,000 births.^v Underlying causes of poor health for women and children include limited availability of timely and reliable health information for decision-making and poor access to and use of health facilities. Pregnant women and mothers may delay seeking care or taking appropriate preventative or curative action^{vi}; may not be able to access appropriate health services^{vi}; or they may access health facilities unnecessarily thereby increasing the load on the already overburdened health system. Lack of transportation, poor infrastructure, and long distances to health centers are barriers to accessing care in a country where nearly 85%^{vii} of the population lives in rural areas. Knowing where to go for care and when are integral to maximizing health care access and utilization and reducing maternal and child mortality.

^{iv} CCPF is funded by a Bill and Melinda Gates Foundation award "Innovations for Maternal, Newborn & Child Health (Innovations)" to Concern Worldwide

^v National Statistical Office, Malawi (2011). Malawi Demographic & Health Survey, 2010. Available at: <http://www.measuredhs.com/publications/publication-FR247-DHS-Final-Reports.cfm>

^{vi} Thorsen, V., Sundby, J. & Malata, A. (2012). Piecing together the maternal death puzzle through narratives: The three delays model revisited. PLoS ONE 7(12), e52090. doi:10.1371/journal.pone.0052090.

^{vii} Central Intelligence Agency (n.d.) Malawi. In The World Factbook. Retrieved 8.16.2013 from: <https://www.cia.gov/library/publications/the-world-factbook/geos/mi.html>

PROJECT OVERVIEW

Chipatala cha pa Foni has three primary objectives in Malawi: improve MNCH case management; improve MNCH health-seeking practices; and increase community confidence in the health system.

To this end, the intervention includes two complimentary services:

1. CCPF's toll-free hotline provides clients with information and advice on issues across the RMNCH continuum of care, and refers callers displaying "danger signs" for further care at a village clinic, health center, or district hospital. Hotline workers are trained in maternal, newborn, and child health using modules from the Ministry of Health's (MOH) Health Surveillance Assistants (HSAs) curriculum. A simple touch-screen device guides hotline workers through point-of-care protocols and records data electronically for monitoring and evaluation purposes. Nurse consultants provide supervision and quality assurance oversight to the hotline workers.
2. CCPF's tips and reminders service provides personalized messages on RMNCH topics, with the choice for those who sign up to receive the message as an SMS or a voice message on a weekly basis. The service targets women of childbearing age or pregnant women, and guardians of children less than one year of age in rural or underserved areas. Messages are personalized for clients based on their week of pregnancy or the child's age. Newborn care is covered both in the post-partum messages for pregnant women, which continue for four weeks after birth, and in the weekly messages for caregivers of children under 1 year of age. Newborn care messages provide information about breastfeeding, nutrition for breastfeeding mothers, vaccinations, sleeping position, and care of the umbilical cord stump to prevent infection. Messages also provide information about signs of illness, and encourage caregivers to bring the baby to a clinic if specific symptoms are observed. The tips and reminders service accommodates individuals who have varying degrees of access to mobile phones. A client can access tips and reminders on his or her personal mobile phone, on a friend or family member's personal mobile phone, or on a voice mailbox accessed by calling a toll-free number from any mobile phone. Community volunteers in each village promote the service and explain and demonstrate its use. In Balaka, the pilot district, volunteers provide access to the service by maintaining a phone for community use. In addition to calling the hotline, clients without mobile phone access can retrieve their weekly message through these community phones.

PROJECT MANAGEMENT, STAFFING AND PARTNERSHIP

In addition to the Innovations team, VillageReach implemented the CCPF pilot in partnership with stakeholders from public, private, and non-governmental sectors.

- *Ministry of Health:* VillageReach worked with MOH throughout the implementation and scale up of CCPF. The team developed relationships with national level MOH through Technical Working Groups and district-level MOH through the District Health Officer (DHO) and the District Health Management Team (DHMT), a committee representing District Hospital heads of department. The District Hospital provides space to operate the CCPF hotline. The hospital location adds to the service's credibility through association with the hospital, as community members see the hotline and tips and reminders as being an extension of the district hospital. In addition, coordinators in charge of MNCH activities review new hotline and tips and reminders content, participate in community outreach, and provide supervision and oversight to hotline staff. This ensures that content for hotline worker training and the tips and reminders service are consistent with District priorities and with national programming in relevant areas.
- *Baobab Health Trust:* VillageReach partnered with a local electronic health organization, Baobab Health, on the design of the hotline software and hardware procurement and adaptation. Because Balaka is a rural area with limited technology infrastructure, Baobab Health designed the touch-screen devices to work in a low-resource environment. The devices also use the same registration system as the main electronic medical records system (EMR) patient registration that Baobab Health developed for the MOH. As this is implemented throughout the country, it will help prevent the duplication of medical records between hospitals and the hotline. VillageReach and Baobab had a formal software development and maintenance contract between the two organizations, which has now moved to a general Service Level Agreement (SLA) for ongoing support of the hotline hardware and software.
- *Airtel:* VillageReach set up a contract with Airtel to be the provider of the toll-free number for the hotline and to host the hotline server in their server room where sufficient power, internet, and infrastructure existed to meet the needs of the hotline technology.
- VillageReach also received technical assistance and support from the *Grameen Foundation's Mobile Technology for Community Health (MOTech)* program in Ghana, which had implemented a similar program in Ghana a year prior to the Innovations pilot test in Malawi. The MOTech team

shared information on technical design, technology set-up, and content creation. VillageReach technology staff then used that background to develop the software to manage the tips and reminders service and to provide reports and data on hotline usage and messaging statistics.

DEVELOPMENT PROCESS

VillageReach piloted CCPF in Balaka District, Malawi from July 2011 to May 2013, and VillageReach is currently expanding CCPF's geographic reach through new partnerships. Hotline content was based on MOH protocols for Integrated Management of Childhood Illnesses (IMCI) and on MOH's Maternal and Newborn Health Community Case management training. District Health Staff cooperated to develop questions and answers for the hotline. To develop the weekly tips and reminders content, VillageReach relied on input from MOTECH and BabyCenter. The implementation team then worked with district and central level MOH staff to adapt the content for rural Malawi. The implementation team consulted experts in Safe Motherhood, Immunization, IMCI, Prevention of Mother to Child Transmission of HIV, Traditional Birth Practices, Family Planning, and Kangaroo Mother Care, and partnered with the USAID Infant and Young Child Nutrition (IYCN) project in Malawi to bring in appropriate nutrition content.

Messages were developed in English, Chichewa and Chiyao. Messages were written in narrative form first, and then turned into shorter SMS messages and recorded as electronic voice files. Final messaging was submitted to and approved by district-level staff.

COSTS

VillageReach is conducting a thorough review of CCPF's financial costs by late 2013. Labor costs during the pilot make up a large portion of the expenses since the technology was being developed, tested, and rolled out during this period. Once the pilot is scaled up, telecom fees will become a larger portion of the costs since they scale with the demand and there is no substantial discount from telecom providers at this point for the services. Voice services are more expensive than SMS or data services, so this is a consideration for CCPF moving forward. As VillageReach and its partners look to scale the service, they are looking at ways to use the less expensive services – like SMS – to reach larger numbers of users, while focusing the voice services (the hotline) on rural and underserved areas where access to quality healthcare is a large barrier.

RESULTS

An independent evaluation using mixed methods was conducted by Invest in Knowledge Initiative (IKI). The cross-sectional population-based survey covered about 2,840 women and 3,620 children at baseline, and 3,850 women and 3,310 children, respectively at endline. Qualitative data was also collected from users, non-users, health center staff, district officials, and implementing partners. Preliminary data from the outcome evaluation indicate that use of CCPF increased home-based and facility-based practices among women, including use of a bed net during pregnancy, attending the recommended four antenatal care (ANC) appointments, starting ANC during first trimester, giving birth in a facility, and receiving a postnatal checkup within 2 days of birth. Home-based practices for children, including exclusive breastfeeding until six months of age, use of bed nets, and use of oral rehydration salts to treat diarrhea also increased. Those that used the service expressed satisfaction with CCPF and found their interactions with the hotline workers to be positive, which many users contrasted with the sometimes negative interactions they had with busy and overburdened health center staff. The full pilot evaluation report will be available in early 2014.

NEXT STEPS

Other organizations have taken up the lessons of CCPF to expand and adapt it to help support the health needs of more women and children in other districts. Moving forward, VillageReach is studying several strategies to expand CCPF and develop a sustainable business plan, with a long-term goal of offering the service nationwide. In 2012, VillageReach received a catalytic grant from the WHO's Innovation Working Group and the mHealth Alliance, providing financial and technical assistance to move the project beyond its pilot phase and support scale-up efforts. The award has enabled VillageReach to work with three additional partners, Concern Worldwide Malawi, Save the Children, and a local traditional leader who is part of the President's Office Safe Motherhood Initiative, to scale-up CCPF services in additional districts. VillageReach established partnership agreements with each entity to support certain resources associated with conducting community outreach and running the hotline and tips and reminders services. The scale-up in each district is structured differently depending on the partners and resources available.

→ See more complete description of [Chipatala cha pa Foni](#).

Sistem Informasi Jejaring Rujukan Maternal & Neonatal (SIJARIEMAS) Referral Exchange System

Indonesia: RTI with EMAS partners (Jhpiego, Budi Kemuliaan Maternity and Children's Hospital, Muhammadiyah, Save the Children)

Referral and Tracking

Scheduling and Tracking Follow Up Visits

Teach and Counsel Mother and Family

Sistem Informasi Jejaring Rujukan Maternal & Neonatal (SIJARIEMAS)^{viii} enables midwives to refer mothers and newborns in emergency situations to hospitals. The system then supports follow up visits and education after mothers return home, as part of the Expanding Maternal and Neonatal Survival (EMAS) program funded by USAID.

PROBLEM STATEMENT

Patient referrals in emergencies to appropriate health facilities can save lives. Yet, the referral system in Indonesia faces delays, including referral for mothers and newborns. Known challenges include delays in seeking care, referring patients, and providing adequate care. Poor coordination and communication among facilities add additional obstacles, resulting in hospitals that are frequently ill-prepared to deal with incoming emergencies and patients being referred to multiple hospitals. Furthermore, new mothers and newborns need better care after they leave facilities to return home.

PROJECT OVERVIEW

SIJARIEMAS uses SMS to reduce delays and enable facilities to prepare for incoming emergencies. A midwife identifies a complication and sends an SMS with patient data, vital-signs, diagnosis and pre-treatment information to the SIJARIEMAS system. The system automatically routes the message to the nearest hospital based on the referral pathway registered into the system, where an alarm is triggered in the emergency room, maternity ward and newborn ward. If accepted, the incoming referral notification is automatically forwarded to the emergency team. If rejected, the system routes the message to the next closest hospital, or informs the health provider at the local health facility to treat the patient locally based on advice from the hospital doctor. Referral hospital staff assess whether they are able to handle the patient (based on bed availability, blood supply, specialists on duty, clinical equipments needed) and either accept or reject the referral.

^{viii} SIJARIEMAS is funded by the USAID/Indonesia "Expanding Maternal and Neonatal Survival (EMAS) Project"

Midwives are kept up to date on the referral status via SMS. For some emergency information, the hospital will make a follow up call to the midwives or midwives can also call doctors at the hospital through the hospital call center. A district based call center triages referrals and ensures that they are received by hospitals; if not, they will coordinate with the head of district health office (DHO) to find a solution. The hospital call center allows the local health center and hospital to coordinate care and to discuss treatment needed pre-referral to stabilize the patient.

The system facilitates follow up after discharge by alerting the referring midwife via SMS and sending her the patient's discharge notes. In addition, it will automatically send SMS to referring midwives to get their feedback on the referral services at the hospital. The system also alerts patients via SMS about post-discharge follow up. Educational messages are sent directly to the family, often the husbands or fathers, based on numbers recorded at hospitals.

In addition to emergency referrals, the system also provides antenatal education messages for mothers and families. Also high-risk mothers are screened by OBGYN doctors based on the diagnoses given by midwives. The system then sends SMS alerts to midwife and local authorities weeks before the due dates of high-risk mothers. The system also supports quick reporting for maternal deaths.

The software was developed using open source software and designed to be integrated with other existing software. A simple design was chosen to avoid the overly sophisticated and unsustainable precedents set by previous health information systems in Indonesia. SIJARIEMAS has been deployed in 6 provinces and 12 districts, with expansion of the network into facilities outside of the EMAS program.

PROJECT MANAGEMENT, STAFFING AND PARTNERSHIP

SIJARIEMAS requires collaboration between EMAS and its stakeholders in the district.

- *EMAS* provides software and IT technical assistance and backstopping. RTI led development of the system in collaboration with other EMAS partners (Jhpiego, Budi Kemuliaan Maternity and Children's Hospital, Muhammadiyah and Save the Children).
- The *district health office* provides policies and oversight of the operation and monitoring process.

- *Participating hospitals* provide hardware, operation and monitoring in their own facilities.

DEVELOPMENT PROCESS

The project was begun in 2011. The needs assessment and design process were the longest stage of development. A user need assessment, sampling interview with stakeholders, and expert workshop were conducted. The software development process lasted three months to release the beta version. The beta version was tested in selected sites in October 2012, refined, and accompanied by table top exercises with stakeholders. The system was launched in 10 districts in November 2012, then rolled out in December 2012. Users received a one-month orientation. The process is time-intensive for staff due to training, oversight and maintenance, requiring the hiring of additional staff. Troubleshooting also requires numerous field visits.

COSTS

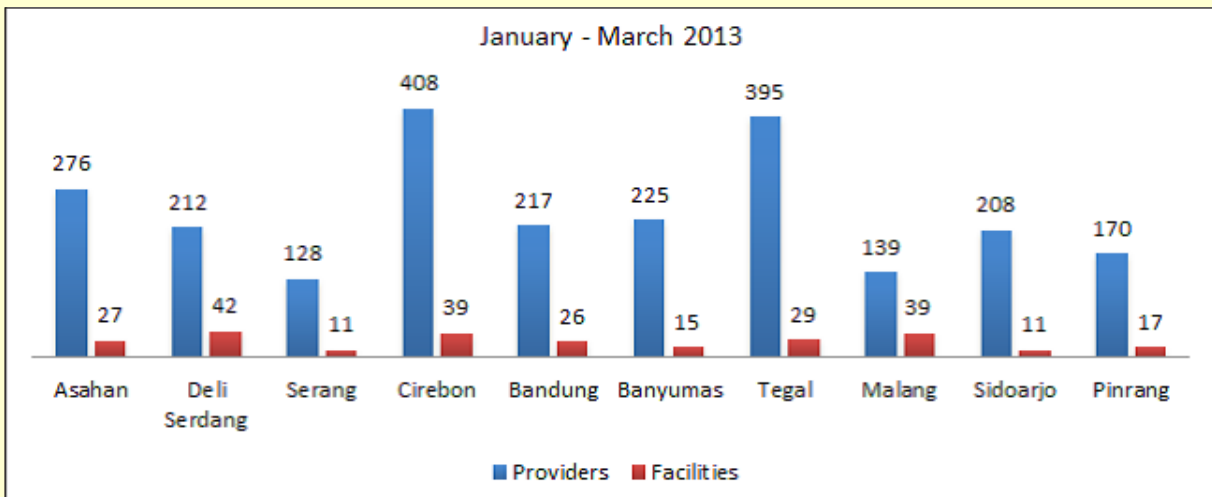
Software developers are available and affordable in Indonesia, costing under \$10,000. The use of open source software reduced development costs. Equipment costs are reduced by the fact that midwives use their own phone and credits, as they are accustomed to using for their own personal use. Nor does SIJARIEMAS fund hospital equipment, as hospitals purchase their own phones and computers. Many hospitals already have computers and internet access. It is also preferred that equipment belong to stakeholders to ensure proper use and care.

Training, mentoring and hardware are significant cost components. The implementation and operating costs are higher than the development costs. However, the implementation and operation costs are shared with stakeholders. For example, in some districts the operational cost is covered by the district health office.

RESULTS

The system referred 7,145 cases between January and September of 2013. Of the referrals, 79.97% were part of a Ministry of Health program that provides women universal free delivery care, including prenatal and postnatal consultations. 90% of referrals were communicated by SMS and 10% by phone calls. 77% of cases are responded to by the hospital in under 10 minutes. 94% of cases are stabilized first at the local health facilities before sending the patient to a hospital.

Registered users and facilities



NEXT STEPS

SIJARIEMAS will trial expansion of the Referral Call Center in several new districts. It will also introduce an Android-based SIJARIEMAS system. It will cover 23 districts in 6 provinces in 2014, including cross-border referrals and referrals from secondary to tertiary hospitals. The project will continue to be promoted to midwives, doctors, hospitals and other districts or provinces.

Implementation Issues and Planning Resources

These case studies revealed a variety of lessons learned. The lessons can be considered within various frameworks for implementation of ICT and health information systems. Such frameworks introduce numerous categories of issues, partially including quality of design of ICT,¹⁵ workflow issues,¹⁶ changes in communication patterns,¹⁷ changes in the power structure,¹⁸ demand,¹⁹ narrow technological approach to ICT,²⁰ modifications to planned implementation,²¹ and costs.²² Similar concepts are repeated in more than one framework, including project planning and management²³ and strong and effective management.²⁴ Also, organizational readiness,²⁵ technical expertise²⁶ and implementation capacity²⁷ are related issues. The relevant issues above are listed below as they relate to lessons from the case studies. Additional resources are included to address related topics for planning mHealth implementation.

Quality of Design

Design quality depends on **sufficient time, budgeting and design methods**. World Vision recommends that sufficient time should be allocated prior to rollout to define the content and technology platform. Measured results varied for the BHAMC project because some modules were started sooner and supported by more refinement and training with CHWs. The BHAMC mobile system can support all of its modules, but results were better where a sufficient development process and schedule were used.

In more than one case study, lack of sufficient time caused implementers to skip steps in needs assessment. In one case, baseline data gathering and rollout were commenced simultaneously, leading to user rejection of some mHealth features. In another case, the system was developed before user capabilities were determined, leading to time-consuming revisions. Early definition of user needs can save time and expense.

Narrow Technological Approach to ICT

Project design should start with **understanding the needs of users and beneficiaries**, recommends CRS. The ReMiND project's operational model and fit with users was more important than the phone. This impacted the project design and schedule. For illiterate CHWs, adapting ReMiND to user needs required additional audio and visual formats in the mHealth application. BHAMC also found that **illiterate** CHWs required additional training and supervision of their mHealth use.

→ See [formative research](#) in the mHealth Planning Guide.

Design that is responsive to the needs of users and beneficiaries can adapt to the following issues of change in communication patterns, power structures and demand.

Changes in Communication Patterns

The introduction of mHealth should fit with the communication patterns and preferences of users. BHAMC found that providing the midwife's phone number to clinic staff would be helpful to coordinate transferring pregnant women to facility care. The SIJARIEMAS project instead found that CHWs prefer sending text messages for referral. Communication preferences can vary by area and user.

Changes in the Power Structure

Gender can influence project design, as demonstrated in Afghanistan where CHWs travel as male-female couples due to security and cultural issues. BHAMC found that male CHWs have greater familiarity with phones, and can provide female CHWs with assistance and social permission to use phones.

→ See [Addressing Gender and Women's Empowerment in mHealth for MNCH](#).

Demand

VillageReach has used several strategies to build demand for its CCPF service for mothers. Initially, VillageReach trained Community Volunteers (CVs) to explain and demonstrate the service through one-on-one meetings and at mobilization events. Volunteers also maintained a community phone to provide access to the service. This strategy was initially successful but new registrations dropped over time, as some CVs became less motivated when initial excitement wore off. VillageReach also heard some reports of volunteers overstepping their role by acting as gatekeepers to the service, instead of communicating to clients that CCPF could be accessed from any Airtel phone. VillageReach is testing additional demand generation strategies, such as registration at health centers, engagement of traditional leaders, and word-of-mouth marketing.

→ See [Demand Generation](#) in the mHealth Planning Guide.

Modifications to Planned Implementation

Unanticipated modification can occur when ICT equipment is unreliable. In one case study, over half the initial batch of inexpensive phones did not function properly. Implementers can choose from a variety of hardware and software tools according to their needs and budgets.

→ See ICT products listed and sorted on the [NetHope Solutions Center](#).

→ See the Selection Matrix in [Planning and Information Systems Project](#).

Some modifications are inevitable when innovative projects are developed iteratively, and this should be included in schedules, budgets and scopes of work. World Vision modified multiple complex HBLSS modules to meet the needs of illiterate CHWs, which required significant time.

To save time, **projects can begin with developing and testing simple features**, then gradually expand the mHealth features as needed. Focusing on a few prioritized features for early testing can be particularly useful when user needs are best determined by testing with users. SIJARIEMAS chose a simple design to make the system more sustainable.

CRS expanded its project to develop an application for CHW supervisors, using a very different design than its preceding application for illiterate CHWs. CRS was able to take a leading role in developing the supervisory application with the onsite support and training from Dimagi's local office.

The modification to implementation above could be influenced by **proximity of partners**. Where the IT partner is co-located in the same country or office, the NGO in the case study was able to adapt and acquire new responsibilities. Local availability allowed quick communications and iterations

of development. This can be helpful because intensive interaction is required in some iterative methodologies. Conversely, distal or asynchronous development between the NGO and IT partners in separate countries caused delays in development and technical assistance in another case study. Distance can be offset by coordinating communications between health and IT partners in advance, from afar, and on a regular basis.

Project Planning and Management

Project planning should **allow sufficient time for design, development and rollout**. Unrealistic time expectations from implementers or funders resulted in design limitations mentioned earlier in this section. Training also took longer than expected in a couple of the case studies. RTI found that collaborative project design with stakeholders required more time than ensuing software development.

As with any project, **staffing** is important. This can be difficult when NGO staff time is divided among many projects. RTI found rollout to be time-intensive for staff to provide training, field visits, oversight and maintenance. **Supervision and monitoring** are also important. VillageReach initially observed high rates of unanswered calls. To determine the cause of the problem, a staff member compared incoming calls to the call system with activity in the hotline room. By monitoring the two processes in real time they learned that the hotline was understaffed at key times, but also that hotline workers were turning off phones which resulted in some missed calls. Peak call times were identified and staffing plans were revised to meet client demand and reduce the rate of unanswered calls. VillageReach also hired a nurse supervisor, which greatly improved hotline worker responsiveness. Appropriate changes decreased the proportion of unanswered calls from about 30% to less than 10%.

- See Form Your Team in [Planning and Information Systems Project](#).
- See [Partnership Development](#) in the mHealth Planning Guide.
- See Create an Implementation Plan in [Planning and Information Systems Project](#).
- See [Project Management](#) in the mHealth Planning Guide.

Costs

Cost information varied by case study. For CCPF, labor costs were a large portion of the expenses while the technology was being developed, tested, and rolled out. Once the CCPF pilot is scaled up, telecom fees will become a larger portion of costs. Voice services are more expensive than SMS or data services. VillageReach reduced CCPF development costs by learning from Grameen Foundation's MOTECH, which had developed a similar application. For SIJARIEMAS, RTI used open source software to **reduce development costs**. Its development costs are lower than its implementation and operating costs. Training, mentoring and hardware are significant cost components. However, the **implementation and operation costs are shared with SIJARIEMAS stakeholders**. Its equipment costs are reduced by using use phones and credits belonging to midwives, as well as phones and computers belonging to hospitals.

- See the [Total Cost of Ownership Model tool](#).

Organizational Capacity

Capacity building is needed and impactful. Several case studies revealed implementers that faced lack of guidance on mHealth. World Vision emphasized the importance of **trainings, guides and technical assistance** to address the difficulties in mHealth projects. CRS attained increasing capacity and responsibility with support from Dimagi's backstopping and training. CRS recommends developing depth and breadth of in-country expertise internally or across partners to enable continuation of mHealth efforts without dependence on an individual or small group to do all work. IT partners also lack capacity in some relevant areas, and generally benefit from better familiarity with design processes for health projects.

Early planning for scale up can avoid major problems at later stages. As case study projects scale up, they encounter other key issues.

Government Commitment and Capacity

Projects need to **align with government goals, manage government expectations and find the right counterparts**. Discussion with state officials is needed to plan feasible time frames and support structures. Issues such as data ownership and storage location can be agreed with the government. Any government responsibility for maintenance and equipment should be determined. Several case studies revealed difficulty in finding the right government counterpart within a ministry, lack of communication between ministry divisions, and turnover in ministry staff. As a project scales from the district to the national level, government counterparts switch from the district to the national level. A joint forum of government officials and local NGOs is needed to harmonize scale up of various local mHealth projects.

Partnerships

Scale up can require **shifting responsibilities to new partners**. VillageReach managed all aspects of the implementation and community outreach during the pilot, but does not find this feasible moving forward. VillageReach plans to provide technical support while shifting implementation responsibilities to partner organizations that manage community outreach and demand generation in the relevant districts. However, it may make sense to keep one partner with the oversight of the technology itself and of the hotline workers.

- See [Scale-up](#) in the mHealth Planning Guide.
- See [Partnerships](#) in the mHealth Planning Guide.
- See [Scale Up](#) in the NetHope Solution Center.

Conclusion

The use of mHealth for newborn health provides many opportunities and challenges. It is hoped this Guide provides a practical insight into how mHealth can serve programmatic and beneficiary needs in newborn health. Further collaboration, capacity building, evidence and knowledge sharing can support the successful use of mHealth for newborn health. For more information, please write to contact@coregroupdc.org. To sign up for the mHealth listserv, please visit <http://www.coregroup.org/get-involved/listserv-sign-up>.

References

1. Save the Children. Newborn Numbers. Healthy Newborn Network, <http://www.healthynewbornnetwork.org/page/newborn-numbers>. Accessed Nov. 18, 2013.
2. Save the Children. State of the World's Mothers 2013. http://www.savethechildren.org/atf/cf/%7B9def2ebe-10ae-432c-9bd0-df91d2eba74a%7D/SOWM-FULL-REPORT_2013.PDF. Published May 2013. Accessed Nov. 18, 2013.
3. The Partnership for Maternal Health, Newborn and Child Health and the Aga Khan University. A Global Review of the Key Interventions Related to Reproductive, Maternal, Newborn and Child Health. http://www.who.int/pmnch/knowledge/publications/201112_essential_interventions/en/. Published 2011. Accessed Nov. 18, 2013.
4. Save the Children. Newborn Numbers. Healthy Newborn Network, <http://www.healthynewbornnetwork.org/page/newborn-numbers>. Accessed Nov. 18, 2013.
5. Save the Children. Newborn Numbers. Healthy Newborn Network, <http://www.healthynewbornnetwork.org/page/newborn-numbers>. Accessed Nov. 18, 2013.
6. The Partnership for Maternal, Newborn & Child Health. Strategic Framework 2012 to 2015. <http://www.who.int/pmnch/activities/strategy/strategy/en/>. Published 2011. Accessed Nov. 18, 2013.
7. Save the Children. Newborn Numbers. Healthy Newborn Network, <http://www.healthynewbornnetwork.org/page/newborn-numbers>. Accessed Nov. 18, 2013.
8. The Partnership for Maternal, Newborn and Child Care and University of Aberdeen. Enable the Continuum of Care. http://www.who.int/pmnch/knowledge/publications/summaries/knowledge_summaries_2_enable_continuum_of_care/en/index.html. Published 2010. Accessed Nov. 18, 2013.
9. K4Health. MHealth Evidence." mHealth Evidence. <https://www.mhealthevidence.org/>. Accessed Nov. 18, 2013.
10. World Bank. Mobile Applications for the Health Sector. http://siteresources.worldbank.org/INFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/mHealth_report.pdf. Published Dec. 2011. Accessed Nov. 18, 2013.
11. Tomlinson M, Rotheram-Borus M, Swartz L, Tsai A. Scaling up MHealth: Where Is the Evidence?" PLoS Medicine. 2012. 10(2): e1001382.
12. Labrique A, Vasudevan L, Chang L, Mehl G. "H_ppe for MHealth: More "y" or "o" on the Horizon?" International Journal of Medical Informatics. 2013; 82(5): 467-69.
13. Macro International. MAMAN Guidelines Minimum Activities for Mothers and Newborns. http://www.mchip.net/sites/default/files/MAMAN_guidelines.pdf. Accessed Nov. 18, 2013.
14. Save the Children. Care of the Newborn Reference Manual. <http://www.savethechildren.org/site/apps/nlnet/content2.aspx?c=8rKLIXMGipl4E&b=6239395&ct=8657765>. Published 2004. Accessed Nov. 18, 2013.
15. The World Bank Group Independent Evaluation Group. Capturing Technology for Development: An Evaluation of World Bank Group Activities in Information and Communication Technologies. <http://ieg.worldbankgroup.org/evaluations/capturing-technology-development>. Published 2011. Accessed Nov. 18, 2013.
16. Ash J, Settig D, Dykstra R, Campbell E, Guappone K. The Unintended Consequences of Computerized Provider Order Entry: Findings From a Mixed Methods Exploration. Int J Med Inform. 2009; 78(Suppl 1): S69–S76.
17. Ash J, Settig D, Dykstra R, Campbell E, Guappone K. The Unintended Consequences of Computerized Provider Order Entry: Findings From a Mixed Methods Exploration. Int J Med Inform. 2009; 78(Suppl 1): S69–S76.
18. Ash J, Settig D, Dykstra R, Campbell E, Guappone K. The Unintended Consequences of Computerized Provider Order Entry: Findings From a Mixed Methods Exploration. Int J Med Inform. 2009; 78(Suppl 1): S69–S76.
19. World Health Organization. mHealth: new horizons for health through mobile technologies: second global survey on eHealth. Global Observatory for eHealth series - Volume 3. http://www.who.int/goe/publications/goe_mhealth_web.pdf. Published 2011. Accessed Nov. 18, 2013.
20. The World Bank Group Independent Evaluation Group. Capturing Technology for Development: An Evaluation of

- World Bank Group Activities in Information and Communication Technologies. <http://ieg.worldbankgroup.org/evaluations/capturing-technology-development>. Published 2011. Accessed Nov. 18, 2013.
21. The World Bank Group Independent Evaluation Group. Capturing Technology for Development: An Evaluation of World Bank Group Activities in Information and Communication Technologies. <http://ieg.worldbankgroup.org/evaluations/capturing-technology-development>. Published 2011. Accessed Nov. 18, 2013.
22. World Health Organization. mHealth: new horizons for health through mobile technologies: second global survey on eHealth. Global Observatory for eHealth series - Volume 3. http://www.who.int/goe/publications/goe_mhealth_web.pdf. Published 2011. Accessed Nov. 18, 2013.
23. Lorenzi N, Riley R. Managing Technological Change- Organizational Aspects of Health Informatics. New York NY: Springer; 2003.
24. The World Bank Group Independent Evaluation Group. Capturing Technology for Development: An Evaluation of World Bank Group Activities in Information and Communication Technologies. <http://ieg.worldbankgroup.org/evaluations/capturing-technology-development>. Published 2011. Accessed Nov. 18, 2013.
25. Lorenzi N, Riley R. Managing Technological Change- Organizational Aspects of Health Informatics. New York NY: Springer; 2003.
26. World Health Organization. mHealth: new horizons for health through mobile technologies: second global survey on eHealth. Global Observatory for eHealth series - Volume 3. http://www.who.int/goe/publications/goe_mhealth_web.pdf. Published 2011. Accessed Nov. 18, 2013.
27. The World Bank Group Independent Evaluation Group. Capturing Technology for Development: An Evaluation of World Bank Group Activities in Information and Communication Technologies. <http://ieg.worldbankgroup.org/evaluations/capturing-technology-development>. Published 2011. Accessed Nov. 18, 2013.

External Resources

[Addressing Gender and Women's Empowerment in mHealth for MNCH](http://mhealthalliance.org/images/content/gender_analytical_framework_report.pdf)

http://mhealthalliance.org/images/content/gender_analytical_framework_report.pdf

[Chipatala cha pa Foni](http://www.mobilemamaalliance.org/sites/default/files/1772-MAMA-Spotlight-September-v3-JH.pdf)

<http://www.mobilemamaalliance.org/sites/default/files/1772-MAMA-Spotlight-September-v3-JH.pdf>

[Healthy Newborn Network](http://www.healthynewbornnetwork.org/)

<http://www.healthynewbornnetwork.org/>

[Leveraging Mobile Technologies for Maternal, Newborn & Child Health](http://mhealthalliance.org/images/content/engagement_framework_levering_mobile_for_mnch.pdf)

http://mhealthalliance.org/images/content/engagement_framework_levering_mobile_for_mnch.pdf

[mHealth and MNCH: State of the Evidence](http://mhealthalliance.org/images/content/un_007_evidencegapreport_digital_aaa.pdf)

http://mhealthalliance.org/images/content/un_007_evidencegapreport_digital_aaa.pdf

[mHealth Basics: Introduction to Mobile Technology for Health](http://www.globalhealthlearning.org/course/mhealth-basics-introduction-mobile-technology-health)

<http://www.globalhealthlearning.org/course/mhealth-basics-introduction-mobile-technology-health>

[mHealth, eHealth, Reproductive Health](http://www.path.org/publications/files/RH_outlook_29_1.pdf)

http://www.path.org/publications/files/RH_outlook_29_1.pdf

[mHealth Evidence database](https://www.mhealthevidence.org/)

<https://www.mhealthevidence.org/>

mHealth innovations as health system strengthening tools: 12 common applications and a visual framework (Figure 1. mHealth and ICT Framework for RMNCH)

http://www.ghspjournal.org/content/early/2013/08/06/GHSP-D-13-00031.full.pdf?utm_content=buffer6b58&utm_source=buffer&utm_medium=twitter&utm_campaign=Buffer

mHealth Planning Guide

<http://www.k4health.org/toolkits/mhealth-planning-guide>

NetHope Solutions Center

<http://solutionscenter.nethope.org/>

Planning and Information Systems Project

http://www.path.org/publications/files/TS_opt_ict_toolkit.pdf

Total Cost of Ownership Model

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0CD0QFjAC&url=https%3A%2F%2Fconfluence.dimagi.com%2Fdownload%2Fattachments%2F14549044%2FDimagi%2520-%2520CommCare%2520-%2520TCO_v5-cp.xlsx%3Fversion%3D1%26modificationDate%3D1370536055234%26api%3Dv2&ei=JWmfUpn1B87qkAe0q4GgBw&usq=AFQjCNGcYH59cpQhH9gHnTCiHU4M6fH3tA&sig2=rKKu3dsd98-9ADCZrJb25jg&bvm=bv.57155469,d.eW0

